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## REVISION HISTORY

Approval

| Date          | Revision No. | Page  | Summary   |
|---------------|--------------|---|---|
| Mar 30. 2011  | P00          | All   | LTN121XL01-N01 Product spec was issued first.   |
| Apr 01. 2011  | P01          | 7<br>10<br>12<br>12   | - CR was changed to Typ.700<br>- Vsync Frequency(40Hz) Information was added<br>- LED Driver IC spec was updated<br>(LED Input Current, LED Input Power)<br>- Explanation for LED Driver IC PWM duty ratio was added  |
| Apr 18. 2011  | P02          | All   | Product Code is changed to LTN121XL01-N02   |
| May 11. 2011  | P03          | 23, 24  | Product Drawing is updated and added  |
| May 12. 2011  | P04          | 31,32,33  | Product EDID is updated   |
| May. 23. 2011 | P05          | 25~28<br>10   | - Packing spec is updated<br>- Main Frequency is changed<br>(96Mhz → 71.29Mhz @ 60Hz, 64.1Mhz → 47.5Mhz @ 40Hz)   |
| Jun. 28. 2011 | P06          | 31~33<br>5  | - 40Hz information in Product EDID<br>- Weight Spec is changed(Typ.210/Max.220 → Typ.200/Max.210 )  |
| Jul. 15. 2011 | P07          | All<br>27   | - Model Code is changed_LTN121XL01-N01 → LTN121XL01-N03<br>- Product Label is changed to small Label for Tablet Product   |
| Aug. 23. 2011 | P08          | 10<br>5<br>7<br>16<br>25<br>21<br>All<br>24<br>7<br>30~32<br>29 | - Current of Power Supply is added<br>- Weight Spec is changed(Typ.200/Max.210 → Typ.199/Max.209 )<br>- Color Chromaticity is added<br>- ROUTCLK Frequency Typ. Value is added<br>- Packing Method is updated<br>- T4 Timing is deleted<br>- Information regarding EDID is deleted<br>- Label in drawing is updated<br>- Color Gamut is updated<br>- Color Chromaticity in Appendix(EDID) is updated<br>- 'Storage' Contents of General Precaution is updated |
| Aug. 24. 2011 | A00          | All   | - LTN121XL01-N03 Approval Product Specification is issued.  |
| Aug. 25. 2011 | A01          | 11<br>16<br>20  | - Max Power Pattern is added<br>- Main Clock is added<br>- Frame Freq. and One Line Scanning Time are added   |
|               |              |   |   |

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## GENERAL DESCRIPTION

### DESCRIPTION

LTN121XL01 is a color active matrix TFT (Thin Film Transistor) liquid crystal display (LCD) that uses amorphous silicon TFT as switching devices. This model is composed of a TFT LCD panel, a driver circuit and a backlight system. The resolution of a 12.1" contains 1024 x 768 pixels and can display up to 262,144 colors. 6 O'clock direction is the Optimum viewing angle.

### FEATURES

- Thin and light weight
- High contrast ratio, high aperture structure
- 1024 x 768 pixels resolution (4:3)
- Fast Response Time
- Low power consumption
- LED BLU Structure
- DE (Data enable) only mode
- 3.3V LVDS Interface
- Pb-free product
- RoHS comply product
- Flicker should be optimized with 2 by 1 half gray green pattern before shipping MP.

### APPLICATIONS

- Notebook PC
- If the usage of this product is not for PC application, but for others, please contact SEC

## GENERAL INFORMATION

| Item              | Specification                            | Unit  | Note       |
|-------------------|--|-------|------------|
| Display area      | 245.76(H) x 184.32mm(V) (12.1" diagonal) | mm    |            |
| Driver element    | a-Si TFT active matrix                   |       |            |
| Display colors    | 262,144                                  |       |            |
| Number of pixel   | 1024 x 768                               | pixel | 4 : 3      |
| Pixel arrangement | RGB vertical stripe                      |       |            |
| Pixel pitch       | 0.240 (H) x 0.240 (V) (TYP.)             | mm    |            |
| Display Mode      | Normally Black, PLS Mode                 |       |            |
| Surface treatment | Haze 25, Hardness 3H                     |       | Anti-Glare |

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## Mechanical Information

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| Item        |                | Min.  | Typ.  | Max.  | Unit | Note |
|-------------|----------------|-------|-------|-------|------|------|
| Module Size | Horizontal (H) | 256.8 | 257.3 | 257.8 | mm   |      |
|             | Vertical (V)   | 198.6 | 199.1 | 199.6 | mm   |      |
|             | Depth (D)      | -     | -     | 4.75  | mm   | (1)  |
| Weight      |                | -     | 199   | 209   | g    |      |

Note (1) Measurement condition of outline dimension

. Equipment : Vernier Calipers

. Push Force : 750g · f (minimum)

## 1. ABSOLUTE MAXIMUM RATINGS

### 1.1 ENVIRONMENTAL ABSOLUTE RATINGS

| Item  | Symbol           | Min. | Max.   | Unit | Note    |
|---|------------------|------|--------|------|---------|
| Storage temperate                                     | $T_{STG}$        | -20  | 60     | °C   | (1)     |
| Operating temperate<br>(Temperature of glass surface) | $T_{OPR}$        | 0    | 45     | °C   | (1)     |
| Shock ( non-operating )                               | S <sub>nop</sub> | -    | 210    | G    | (2),(5) |
|   |                  |      | 50     |      | (3),(5) |
| Vibration (non-operating)                             | V <sub>nop</sub> | -    | 2.41   | G    | (4),(5) |
| Altitude ( operation )                                | -                | -    | 10,000 | feet |         |
| Altitude ( storage )                                  | -                | -    | 40,000 | feet |         |

Note (1) Temperature and relative humidity range are shown in the figure below.

95 % RH Max. ( 40 °C > T<sub>a</sub> )

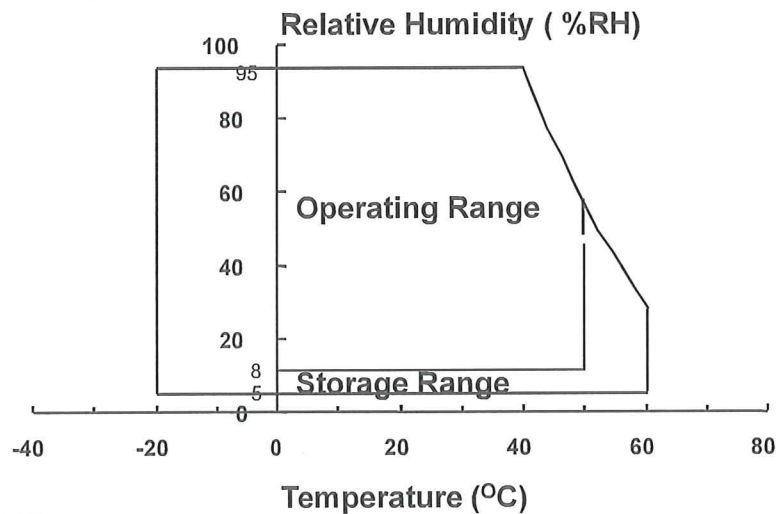
Maximum wet - bulb temperature at 39 °C or less. (T<sub>a</sub> ≥ 40 °C) No condensation.

(2) 2ms, half sine wave, one time for ±X, ±Y, ±Z.

(3) 11ms, Trapezoidal wave, one time for ±X, ±Y, ±Z.

(4) 5~500 Hz, Random vibration, 30 min for X,Y,Z.

(5) At testing Vibration and Shock, the fixture in holding the Module to be tested have to be hard and rigid enough so that the Module would not be twisted or bent by the fixture.



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## 1.2 ELECTRICAL ABSOLUTE RATINGS

## (1) TFT LCD MODULE

 $V_{DD} = 3.3V$ ,  $V_{SS} = GND = 0V$ 

| Item                 | Symbol   | Min.           | Max.           | Unit | Note |
|----------------------|----------|----------------|----------------|------|------|
| Power Supply Voltage | $V_{DD}$ | $V_{DD} - 0.3$ | $V_{DD} + 0.3$ | V    | (1)  |
| Logic Input Voltage  | $V_{DD}$ | $V_{DD} - 0.3$ | $V_{DD} + 0.3$ | V    | (1)  |

Note (1) Within  $T_a$  ( $25 \pm 2$  °C )

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## 2. OPTICAL CHARACTERISTICS

The following items are measured under stable conditions. The optical characteristics should be measured in a dark room or equivalent state with the methods shown in Note (5).

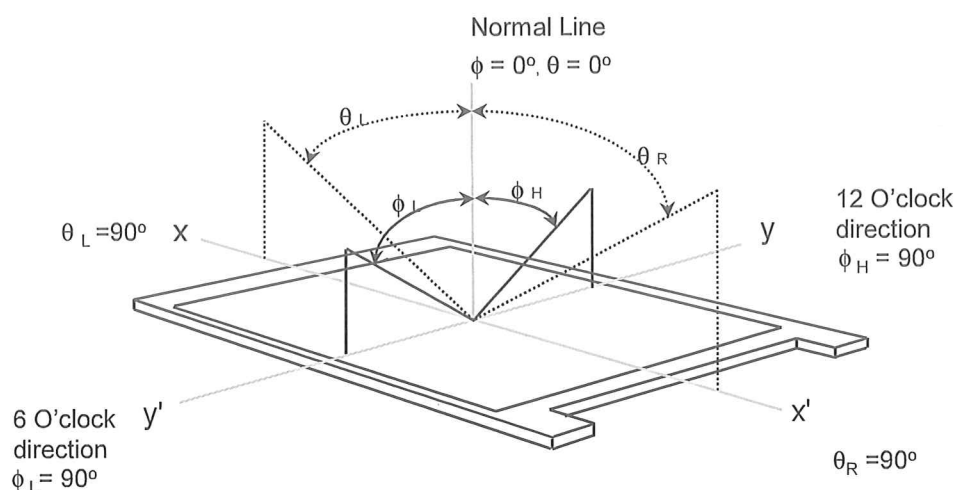
Measuring equipment : TOPCON SR-3

\* Ta =  $25 \pm 2$  °C, V<sub>DD</sub>=3.3V, fv= 60Hz, fDCLK = 96.1 MHz, PWM duty = 100%

| Item  |       | Symbol                          | Condition                              | Min.  | Typ.  | Max   | Unit              | Note                |
|---|-------|---------------------------------|--|-------|-------|-------|-------------------|---------------------|
| Contrast Ratio                              |       | CR                              | 1center point                          | 500   | 700   | -     | -                 | (1), (2), (5)       |
| Response Time at Ta<br>( Rising + Falling ) |       | T <sub>R</sub> + T <sub>F</sub> |  | -     | 30    | 45    | msec              | (1), (3)            |
| Average Luminance of White                  |       | Y <sub>L,AVE</sub>              | 1center point                          | 240   | 300   | -     | cd/m <sup>2</sup> | PWM duty = 100% (4) |
| Color Chromaticity<br>( CIE 1931 )          | Red   | R <sub>X</sub>                  | Normal Viewing Angle<br>ϕ = 0<br>θ = 0 | 0.560 | 0.590 | 0.620 | -                 | (1), (5)<br>SR-3    |
|   |       | R <sub>Y</sub>                  |  | 0.330 | 0.360 | 0.390 |                   |                     |
|   | Green | G <sub>X</sub>                  |  | 0.300 | 0.338 | 0.368 |                   |                     |
|   |       | G <sub>Y</sub>                  |  | 0.525 | 0.555 | 0.585 |                   |                     |
|   | Blue  | B <sub>X</sub>                  |  | 0.124 | 0.154 | 0.184 |                   |                     |
|   |       | B <sub>Y</sub>                  |  | 0.090 | 0.120 | 0.150 |                   |                     |
|   | White | W <sub>X</sub>                  |  | 0.283 | 0.313 | 0.343 |                   |                     |
|   |       | W <sub>Y</sub>                  |  | 0.299 | 0.329 | 0.359 |                   |                     |
| Viewing Angle                               | Hor.  | θ <sub>L</sub>                  | CR ≥ 10                                | -     | 80    | -     | Degrees           | (1), (5)            |
|   |       | θ <sub>R</sub>                  |  | -     | 80    | -     |                   |                     |
|   | Ver.  | ϕ <sub>H</sub>                  |  | -     | 80    | -     |                   |                     |
|   |       | ϕ <sub>L</sub>                  |  | -     | 80    | -     |                   |                     |
| Color Gamut                                 |       |                                 |  | -     | 46.5  | -     | %                 |                     |
| 13 Points White Variation                   |       | δ <sub>L</sub>                  |  | -     | -     | 1.7   | -                 | (6)                 |

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Note 1) Definition of Viewing Angle : Viewing angle range( $10 \leq C/R$ )

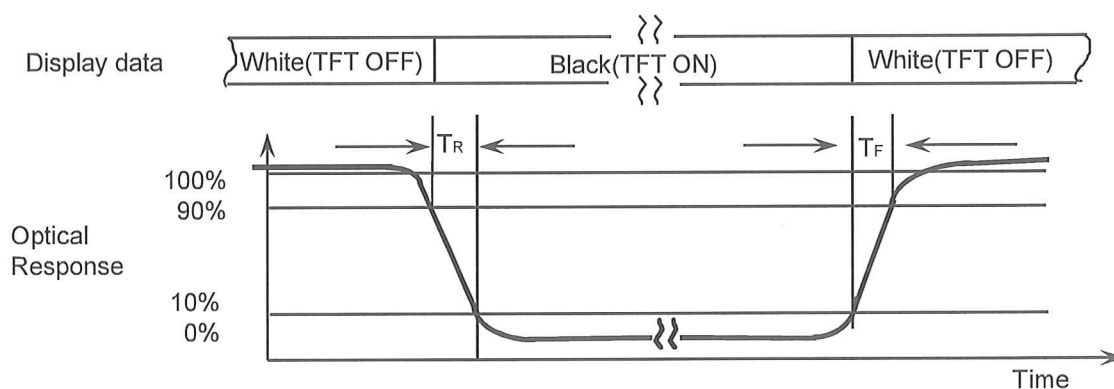


Note 2) Definition of Contrast Ratio (CR) : Ratio of gray max (Gmax), gray min (Gmin) at 5 points(4, 5, 7, 9, 10)

$$CR = \frac{CR(4) + CR(5) + CR(7) + CR(9) + CR(10)}{5}$$

Points : (4), (5), (7), (9), (10) at the figure of Note (6).

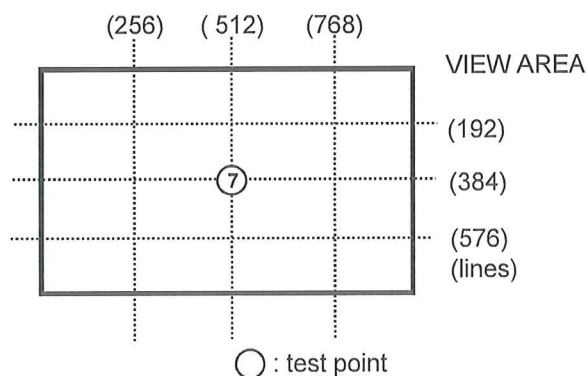
Note 3) Definition of Response time :



Note 4) Definition of Average Luminance of White : measure the luminance of white at 1 point.

. Center 1point of White ( $Y_{L,AVE}$ )

$$Y_{CENTER} = Y_{L7}$$

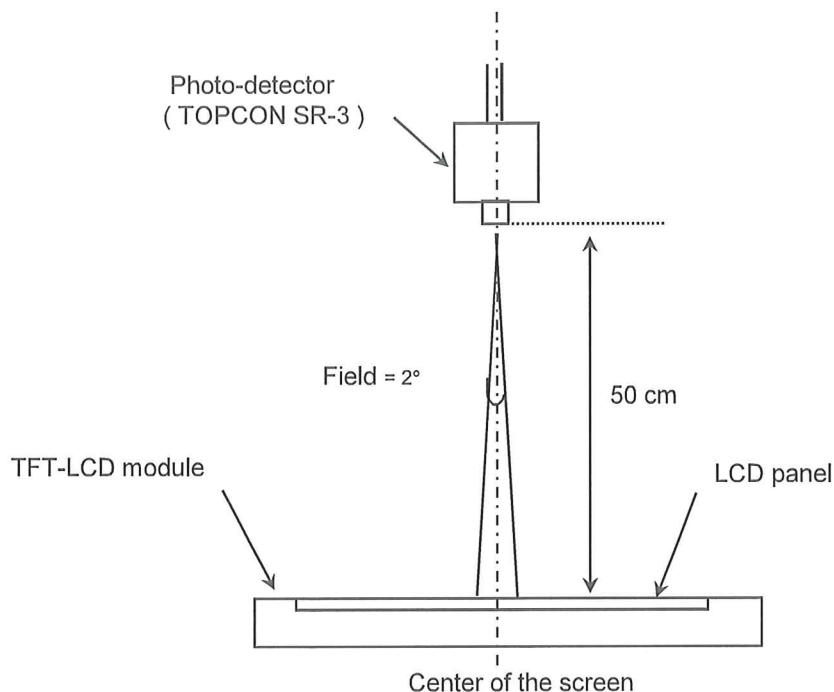


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Note 5) After stabilizing and leaving the panel alone at a given temperature for 30 min, the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. 30 min after lighting the backlight. This should be measured in the center of screen.

LED current : 22.0 mA

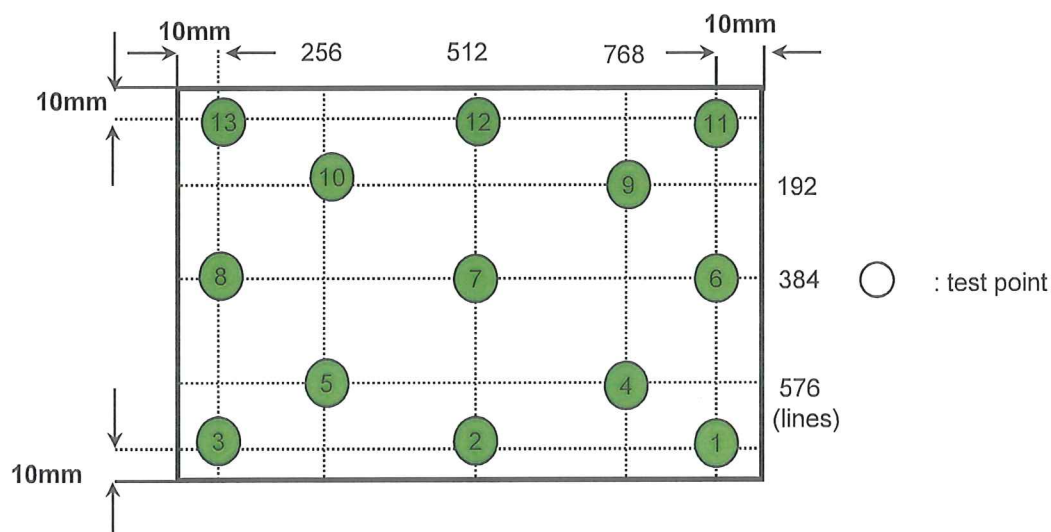
Environment condition :  $T_a = 25 \pm 2 \text{ }^{\circ}\text{C}$



[ Optical characteristics measurement setup ]

Note 6) Definition of 13 points white variation ( $\delta_L$ ), [ ① ~ ⑬ ]

$$\delta_L = \frac{\text{Maximum luminance of 13 points}}{\text{Minimum luminance of 13 points}}$$



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### 3. ELECTRICAL CHARACTERISTICS

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#### 3.1 TFT LCD MODULE

Ta= 25 ± 2°C

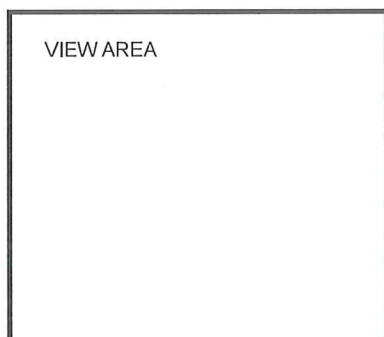
| Item   |           | Symbol            | Min.              | Typ. | Max.  | Unit | Note      |   |
|--|-----------|-------------------|-------------------|------|-------|------|-----------|---|
| Voltage of Power Supply                                |           | V <sub>DD</sub>   | 3.0               | 3.3  | 3.6   | V    |           |   |
| Differential Input Voltage for LVDS Receiver Threshold |           | High              | V <sub>IH</sub>   | -    | -     | +100 | mV        | V <sub>CM</sub> = +1.2V   |
|  |           | Low               | V <sub>IL</sub>   | -100 | -     | -    | mV        |   |
| Vsync Frequency (fv)                                   | 60Hz      | Hsync Freq        | f <sub>H</sub>    | -    | 47.4  | -    | KHz       | Guarantee only for electrical operation.<br>No FOS quality guarantee. |
|  |           | Main Freq         | f <sub>DCLK</sub> | 64.1 | 71.29 | 80.3 | MHz       |   |
|  | 40Hz      | Hsync Freq        | f <sub>H</sub>    | -    | 31.6  | -    | KHz       |   |
|  |           | Main Freq         | f <sub>DCLK</sub> | -    | 47.5  | -    | MHz       |   |
| Rush Current   |           | I <sub>RUSH</sub> | -                 | -    | 1.5   | A    | (4)       |   |
| Current of Power Supply                                | White     | I <sub>DD</sub>   | -                 | 230  | -     | mA   | (2),(3)*a |   |
|  | Mosaic    |                   | -                 | 230  | -     | mA   | (2),(3)*b |   |
|  | 1 Dot Ver |                   | -                 | 220  | -     | mA   | (2),(3)*c |   |
|  | Black     |                   |                   | 180  |       |      | (2),(3)*d |   |
|  | Max.      |                   | -                 | 280  | 300   | mA   | (2),(3)*e |   |

**Note (1)** Display data pins and timing signal pins should be connected.( GND = 0V )

**(2)** f<sub>v</sub> = 60Hz, f<sub>DCLK</sub> = 71.29MHZ, V<sub>DD</sub> = 3.3V , DC Current.

**(3)** Power dissipation pattern75

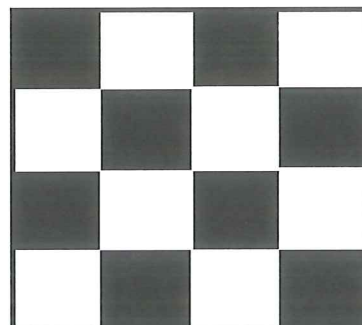
\*a) White Pattern



Display Brightest Gray Level →

Display Darkest Gray Level →

\*b) Mosaic Pattern



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**Doc.No.**

LTN121XL01-N03

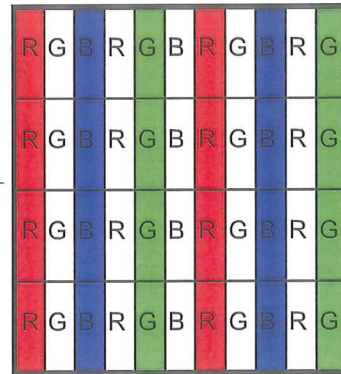
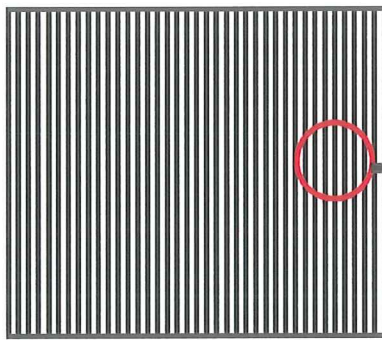
**Rev.No**

04-A01-G-110825

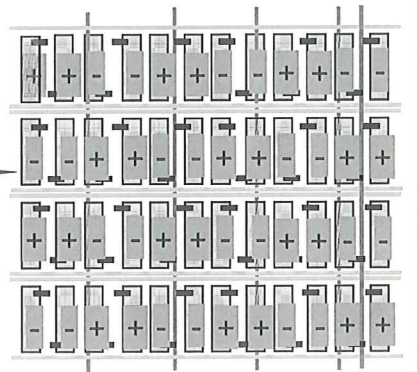
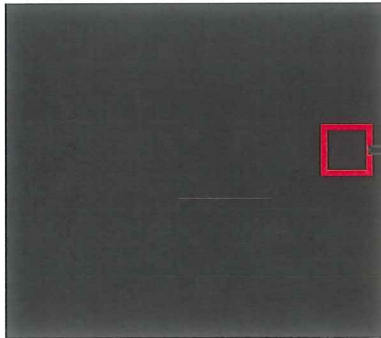
**Page**

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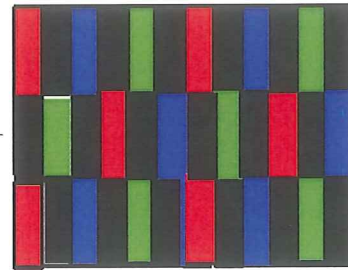
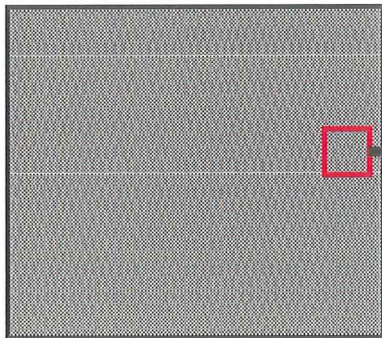
\*c) 1dot Vertical stripe pattern



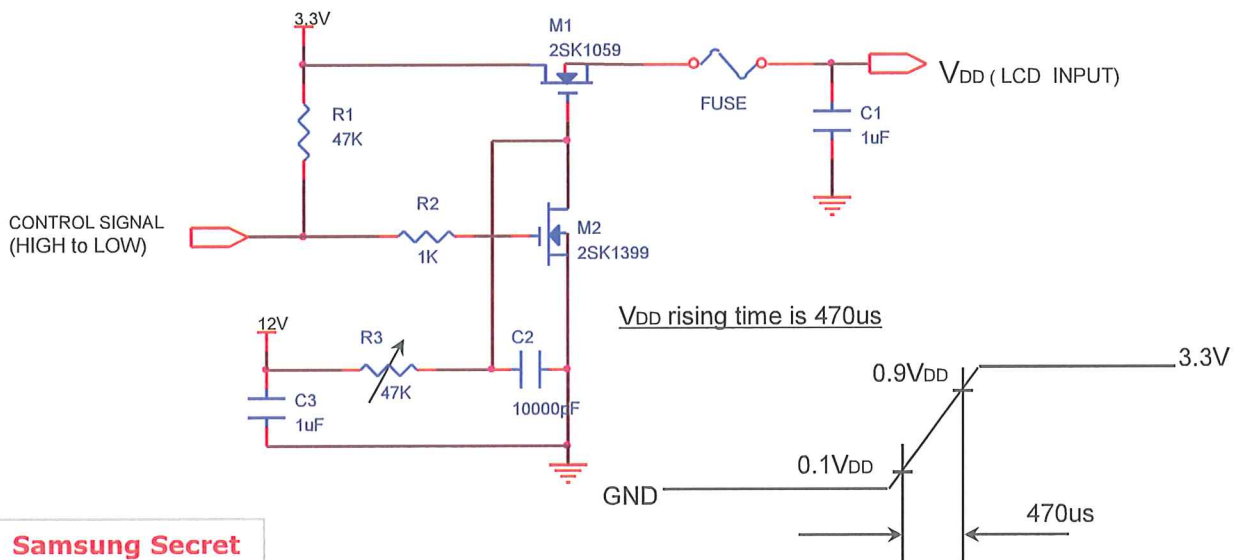
\*d) Black



\*e) Max pattern : 1 Dot



4) Rush current measurement condition



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## 3.2 BACK-LIGHT UNIT

Ta= 25 ± 2 °C

| Item                | Symbol | Min.   | Typ. | Max. | Unit | Note |
|---------------------|--------|--------|------|------|------|------|
| Operating Life Time | Hr     | 10,000 | -    | -    | Hr   | (1)  |

Note (1) Life time (Hr) of LEDs can be defined as the time in which it continues to operate under the condition Ta= 25 ± 2 °C and PWM duty = 100% until one of the following event occurs.

- When the brightness becomes 50% or lower than the original.

## 3.3 LED Driver

- LED Driver Manufacturer : Richtek (RT8510)

Ta= 25 ± 2 °C

| Item                   | Symbol    | Min. | Typ.   | Max.   | Unit | Note          |
|------------------------|-----------|------|--------|--------|------|---------------|
| Input Voltage          | VBL       | 7    | 12     | 21     | V    |               |
| VLED on level voltage  | VLED_on   | 7    | -      | 21     | V    |               |
| VLED off level voltage | VLED_off  | 0    | -      | 2      | V    |               |
| Input Current          | I         | -    | (250)  | (270)  | mA   |               |
| Input Power            | Pin       | -    | (3.00) | (3.24) | W    | Pin = VBL x I |
| PWM duty ratio         | -         | 1    | -      | 100    | %    | (1)           |
| PWM Frequency          | FPWM      | 0.12 | -      | 30     | KHz  | (2)           |
| PWM Impedance          | ZPWM      | 2.4  | -      | -      | Mohm |               |
| PWM high level vol.    | VPWM_H    | 2.0  | -      | 5.0    | V    |               |
| PWM low level vol.     | VPWM_L    | 0    | -      | 0.5    | V    |               |
| LED_EN Impedance       | ZPWM      | 50   | -      | -      | Mohm |               |
| LED_EN high vol.       | VLED_EN_H | 2.0  | -      | 5.0    | V    |               |
| LED_EN low vol.        | VLED_EN_L | 0    | -      | 0.8    | V    |               |
| LED rush current       | ILED RUSH | -    | -      | 1.5    | A    |               |

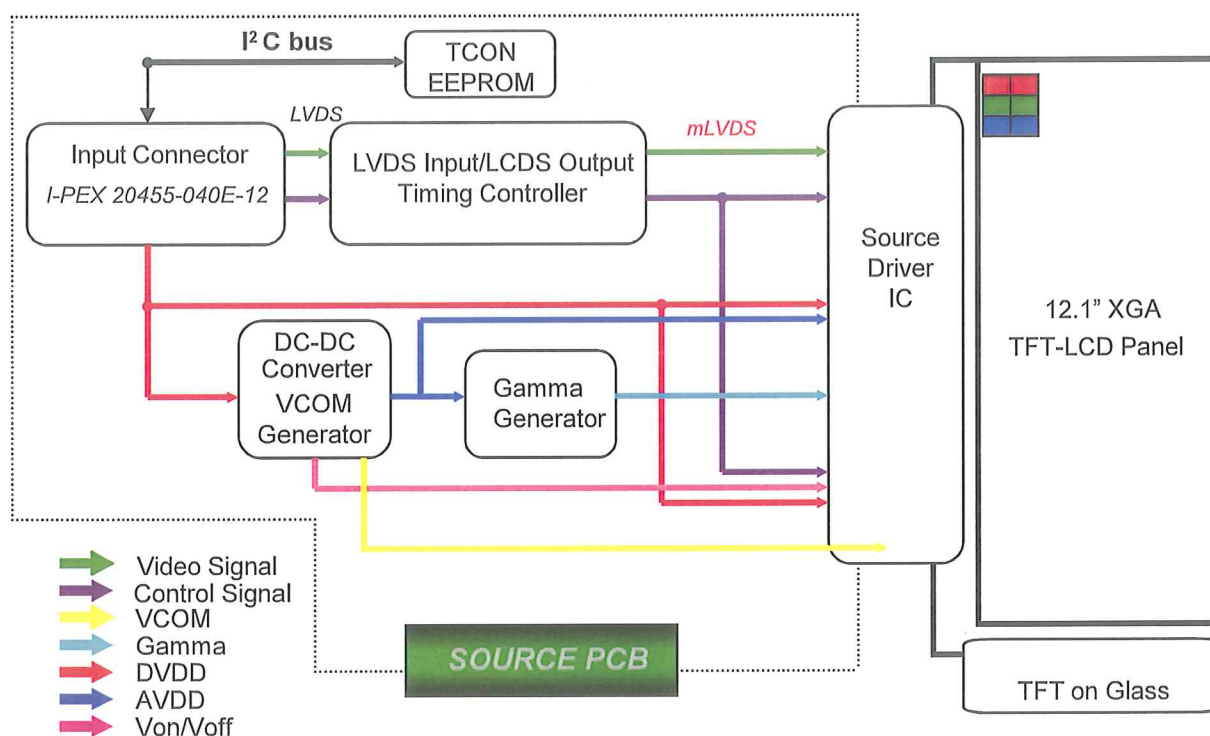
Note - (1) Duty 1% for the frequency range from 120Hz to 1kHz

(2) PWM can be guaranteed under the same condition as operation temperature TOPR 0 ~ 50 °C.

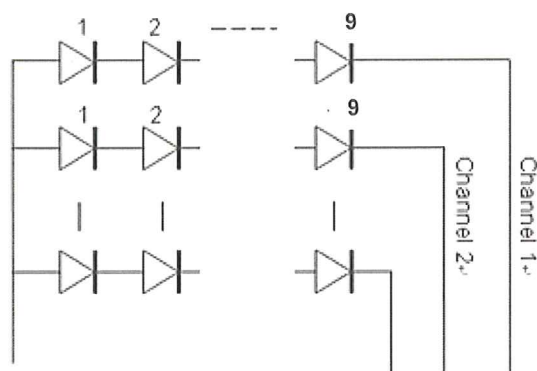
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## 4. BLOCK DIAGRAM

### 4.1 TFT LCD Module

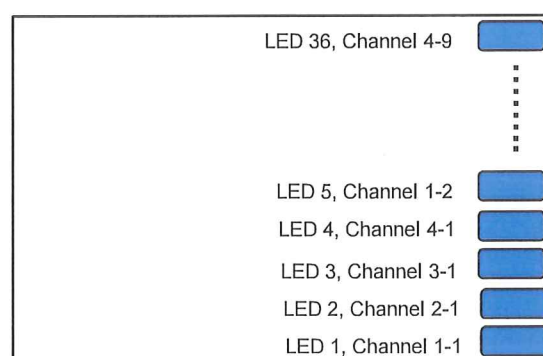


### 4.2 LED connection and placement



9 LEDs x 4 channels = Total 36 LEDs

LED Wiring



LED Placement

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## 5. INPUT TERMINAL PIN ASSIGNMENT

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5.1. Input Signal & Power LVDS, Connector : I-PEX 20455-040E-02S  
Mating Connector: I-PEX 20454-040T-01 or 02

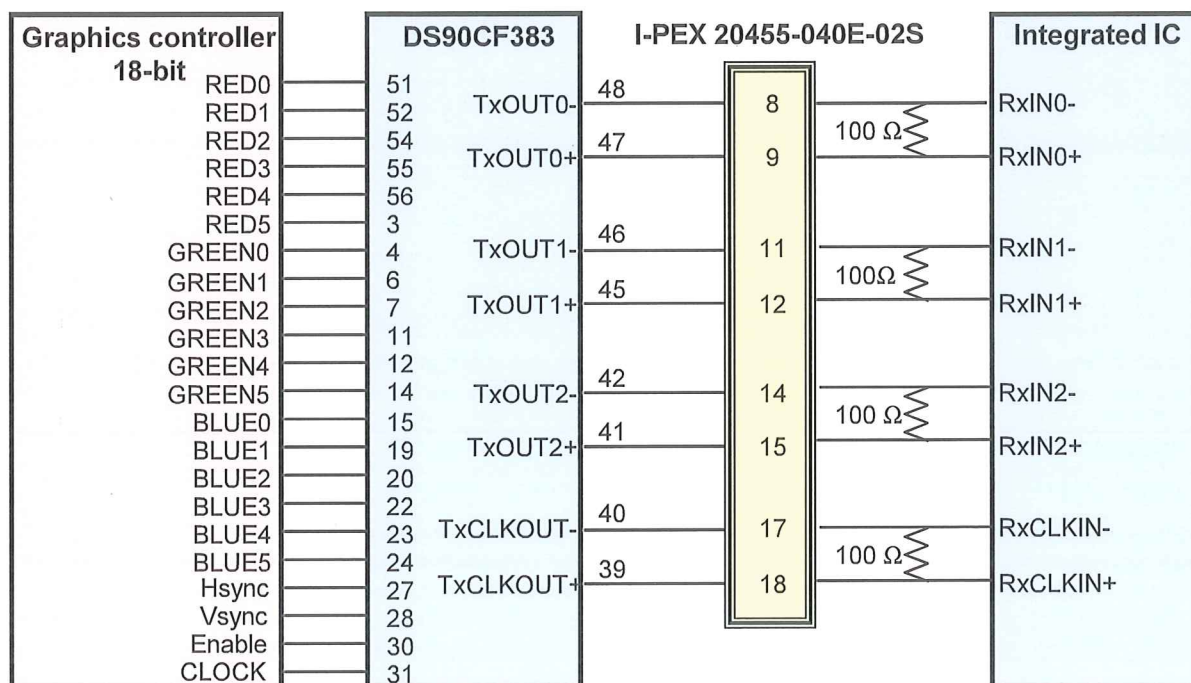
| Pin   | Symbol    | Function                                   |
|-------|-----------|--|
| 1     | NC        | No Connection                              |
| 2     | VCC       | Power Supply, 3.3V (typical)               |
| 3     | VCC       | Power Supply, 3.3V (typical)               |
| 4     | NC        | No Connection                              |
| 5     | NC        | No Connection                              |
| 6     | NC        | No Connection                              |
| 7     | NC        | No Connection                              |
| 8     | RXin0-    | - LVDS differential data (R0-R5, G0)       |
| 9     | RXin0+    | + LVDS differential data (R0-R5, G0)       |
| 10    | GND       | Ground                                     |
| 11    | RXin1-    | - LVDS differential data (G1-G5, B0-B1)    |
| 12    | RXn1+     | + LVDS differential data (G1-G5, B0-B1)    |
| 13    | GND       | Ground                                     |
| 14    | RXin2-    | - LVDS differential data (B2-B5,HS,VS, DE) |
| 15    | RXn2+     | + LVDS differential data (B2-B5,HS,VS, DE) |
| 16    | GND       | Ground                                     |
| 17    | CIkIN-    | - LVDS differential clock input            |
| 18    | CIkIN+    | + LVDS differential clock input            |
| 19    | GND       | Ground                                     |
| 20~21 | NC        | No Connection                              |
| 22    | GND       | Ground                                     |
| 23~24 | NC        | No Connection                              |
| 25    | GND       | Ground                                     |
| 26~27 | NC        | No Connection                              |
| 28    | GND       | Ground                                     |
| 29~30 | NC        | No Connection                              |
| 31~33 | GND       | LED Ground                                 |
| 34    | NC        | No Connection                              |
| 35    | PWM       | PWM for luminance control                  |
| 36    | LED_EN    | BL On/Off (On: 2.0~5.0V, Off: 0~0.8V)      |
| 37    | NC        | APS_EN                                     |
| 38~40 | VBL(7~21) | *LED Power Supply 7V-21V                   |

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## 5.2 LVDS Interface : Transmitter DS90CF363 or Compatible

| Pin No. | Name   | RGB Signal | Pin No. | Name    | RGB Signal |
|---------|--------|------------|---------|---------|------------|
| 51      | TxIN0  | R0         | 14      | TxIN14  | G5         |
| 52      | TxIN1  | R1         | 15      | TxIN15  | B0         |
| 54      | TxIN2  | R2         | 19      | TxIN18  | B1         |
| 55      | TxIN3  | R3         | 20      | TxIN19  | B2         |
| 56      | TxIN4  | R4         | 22      | TxIN20  | B3         |
| 3       | TxIN6  | R5         | 23      | TxIN21  | B4         |
| 4       | TxIN7  | G0         | 24      | TxIN22  | B5         |
| 6       | TxIN8  | G1         | 27      | TxIN24  | Hsync      |
| 7       | TxIN9  | G2         | 28      | TxIN25  | Vsync      |
| 11      | TxIN12 | G3         | 30      | TxIN26  | DE         |
| 12      | TxIN13 | G4         | 31      | TxCLKIN | Clock      |

**LVDS INTERFACE**

Note : The LCD Module uses a 100ohm resistor between positive and negative lines of each receiver input.

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## 5.3 LVDS characteristics

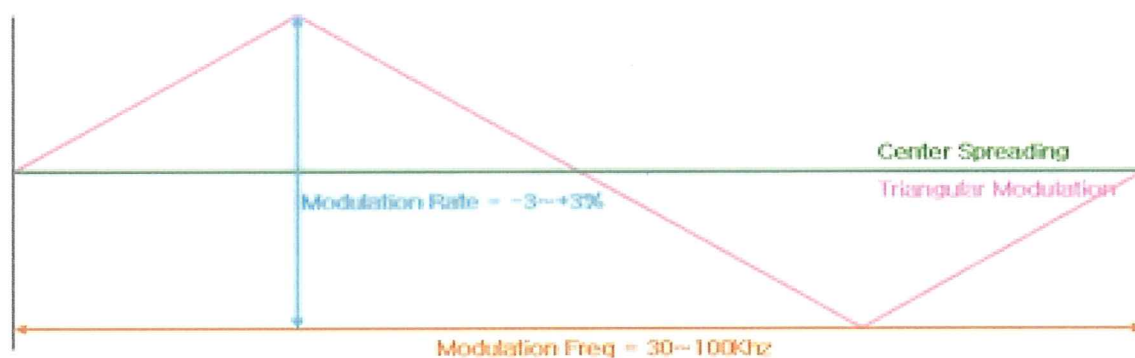
## LVDS DC Specifications

| Characteristics                           | Symbol | Conditions                      | Min | Typ | Max | Unit |
|---|--------|---------------------------------|-----|-----|-----|------|
| Differential input high threshold voltage | VTH    | Vcm = 1.2V                      | 100 |     |     | mV   |
| Differential input low threshold voltage  | VTL    |                                 | 100 |     |     | mV   |
| Differential input voltage                | Vid    |                                 | 100 |     | 600 | mV   |
| Common mode voltage                       | Vcm    | Vid  = 100mV,<br>AVDD33I = 3.3V | 0.4 | 1.2 | 2.9 | V    |

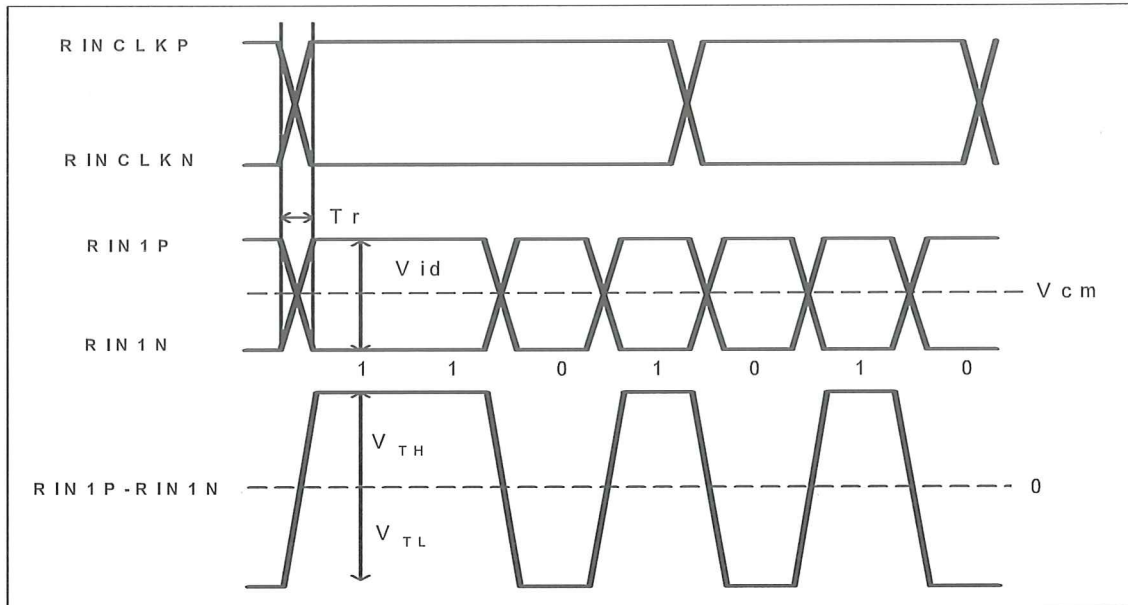
## LVDS AC Specifications

| Characteristics                               | Symbol   | Min      | Typ   | Max  | Unit | Remarks             |
|---|----------|----------|-------|------|------|---------------------|
| ROUTCLK frequency                             | fRCP     |          | 71.29 |      | MHz  | –                   |
| TTL data set-up to ROUTCLK                    | tRS      | 0.3/fRCP |       |      | ns   |                     |
| TTL data hold from ROUTCLK                    | tRH      | 0.3/fRCP |       |      | ns   |                     |
| Skew (Strobe) right margin                    | TRSRM    |          |       | 500  | ps   |                     |
| Skew (Strobe) left margin                     | TRSLM    |          |       | 500  | ps   |                     |
| LVDS clock to clock skew margin (Even to odd) | Tskew_eo | -1/7     |       | +1/7 | Tclk | –                   |
| Unit delay width in skew control block        | $\Delta$ |          | 100   |      | ps   | @NN, 55°C, 2.5/1.2V |

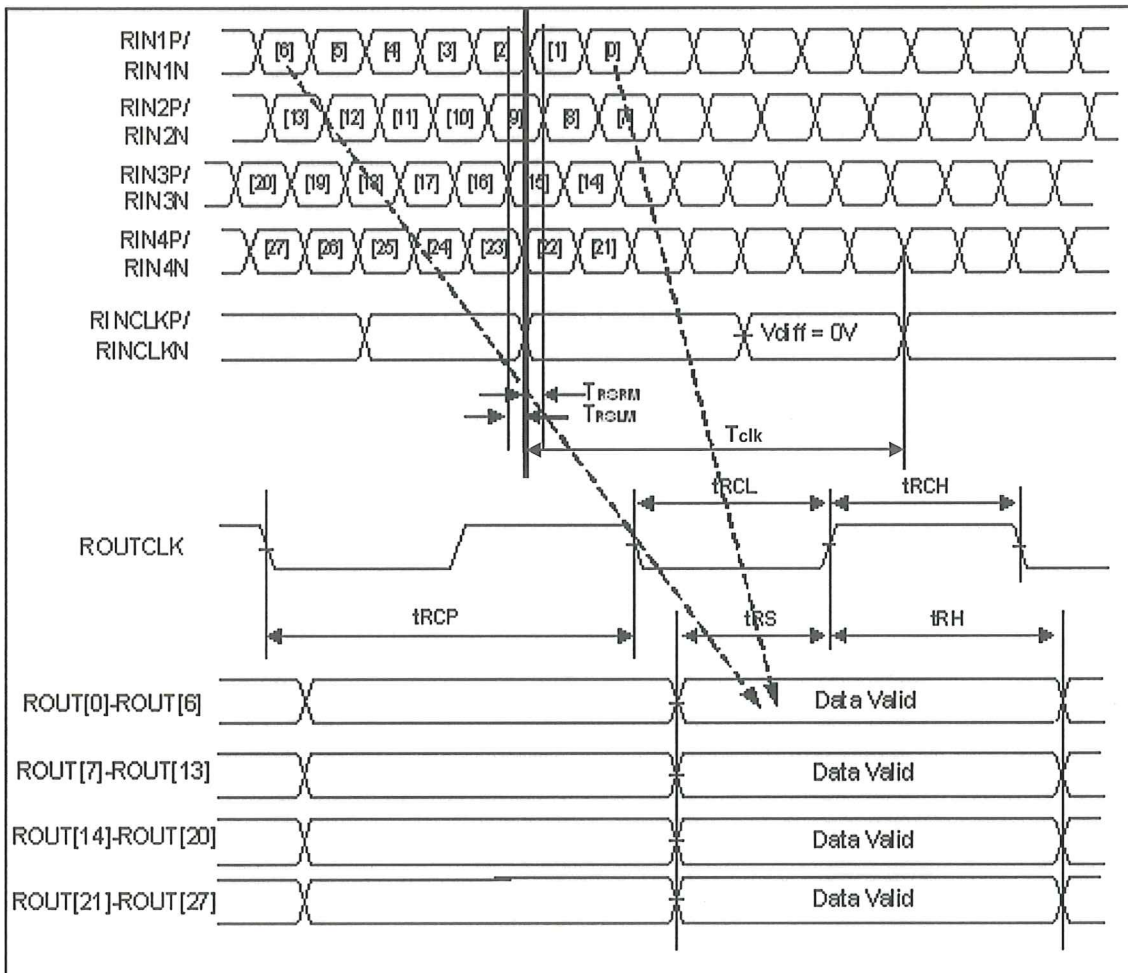
| Characteristics      | Symbol | Min | Typ | Max | Unit | Remarks              |
|----------------------|--------|-----|-----|-----|------|----------------------|
| Modulation Rate      | Fmr    | -3  |     | 3   | %    | @ MAINCLK = 71.29MHz |
| Modulation Frequency | Fmf    | 30  |     | 300 | Khz  |                      |



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&lt; Definition of LVDS DC characteristics &gt;



&lt; Definition of LVDS AC characteristics &gt;

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